Pollutant concentration measuring methods

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Requirements for the method of measurement

The choice of the method of measurement depends on:

- ✓ the measuring method 's selectivity to normalized measuring pollutants in the presence of interfering components;
- ✓ the concentration range which should be covered the meanings from minimum concentrations up to maximum ones which are 10 times higher than the available level of the these pollutants in the atmospheric air;
- ✓ the weight, the dimensions of the used measuring tools (MT), while using the "on-line" (express) measuring method.

Two methods of measurement are possible:

- ✓ on-line (express) analysis of pollutants directly in the interior air of the test vehicles;
- ✓ stationary analysis of pollutants in the laboratory after preliminary sampling of air to the sealed bags, pipettes, sorption tubes and cartridges.

When the MT have the optimum dimensions and the required technical parameters, on-line measurement of the pollutants should be carried out preferably.

Measuring methods

Substances	Russia	OICA
CH_2O	1) high performance liquid chromatography UV detection; 2) gas chromatography with nitrogen phosphorus detection, or mass spectrometer and capillary or packed columns; 3) photo-electric colorimetric method	1) high performance liquid chromatography, UV detection; 2) gas chromatography with nitrogen phosphorus detection, or mass spectrometer and capillary or packed columns; 3) photo-electric colorimetric method
NO, NO_2	1) chemiluminiscence; 2) high-sensitivity electrochemical detection;	1) chemiluminiscence; 2) high-sensitivity electrochemical detection;
CO	1) infrared photoacoustic spectroscopy; 2) electrochemical detection;	1) infrared photoacoustic spectroscopy; 2) electrochemical detection; Infrared is the most accurate. Calibration process to be specified for all the substances
C_2H_6-C_7H_{16}	1) FID (Flame ionization detector), capillary and packed columns gas chromatography;	no need
CH_4	1) FID or TCD (thermal conductivity detector) gas chromatography 2) infrared photoacoustic spectroscopy	For natural gas vehicles - 1) PID or TCD (thermal conductivity detector) gas chromatography 2) infrared photoacoustic spectroscopy

Rationing of pollution in Russia and WHO

Substances	Russia Maximum allowable concentrations of pollutants in the air of residential areas (maximum short-term concentration), mg\m^3	WHO (World Health Organization) Air quality guidelines, mg\m^3
CH_2O	0.05	0.1 (30-minute average concentration)
NO_2	0.2	0.2 (1-hour)
NO	0.4	undefined
CO	5.0	undefined
$PM_{2.5}$	0.16	0.025 (24-hour)
PM_{10}	0.3	0.05 (24-hour)

The lower and upper limits of measurable concentrations for some pollutants

The measuring tools should provide the lower and upper limits of pollutants measurable concentrations at the presence of associated components

Pollutant name	Lower limit of measurement, not less than mg/m^3	Upper limit of measurement, not more than, mg/m^3
Formaldehyde CH_2O	0.015	0.5
Nitrogen dioxide NO_2	0.02	2.0
Nitrogen oxide NO	0.03	4.0
Carbon monoxide CO	1.0	50.0
Particulate matter $PM_{2.5}$	0.002	0.3
Particulate Matter PM_{10}	0.001	0.5

Measuring methods (proposals for M.R.3)

Substances	Proposed measuring methods	Type of analysis
CH_2O	1) High performance liquid chromatography (HPLC) UV detection	1) Stationary analysis at the laboratory after preliminary air sampling to the cartridges
	2) Gas chromatography (GC) with nitrogen phosphorus detection (NPD), or mass spectrometer (MS) and capillary or packed columns	2) Stationary analysis at the laboratory after preliminary air sampling to the cartridges
	3) Photo-electric colorimetric method	3) On-line (express) analysis
NO, NO_2	1) Chemiluminiscence (CLD)	1) On-line (express) analysis or stationary analysis at the laboratory after preliminary air sampling to the sealed bags
	2) High-sensitivity electrochemical detection (ECD)	2) On-line (express) analysis
CO	1) Infrared photoacoustic spectroscopy	1) On-line (express) analysis
	2) Electrochemical detection (ECD)	2) On-line (express) analysis
$PM_{2,5}$ PM_{10}	1) Light-scattering laser photometer	1) On-line (express) analysis

Calibration process

There is a need for additional calibration of analytical equipment, especially while their using at the extreme conditions. For a example -carrying out of quantitative measurements of pollutants on board of test vehicles during the road test, when it is possible to violation of gas analyzer's settings during on-line analysis due to possible disruption of the horizontal installation of equipment, the impact of vibration and speed/acceleration loads and other factors of instability. In these cases, an additional laboratory calibration of the measurement tools is carried out twice – before and after the test. When the results of in-laboratory calibration before the start and after finishing of testing have been exceed the required basic relative error β, gas analyzers settings are checked and after that the calibration procedure should be repeated. The general rule for calibration procedure - the values of β in all cases should not exceed the required values (±25%).

Thank you for your attention!

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